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BUREAU OF MINES EXPLORATION OF MERCURY DEPOSITS TO JUNE 30, 1944

BY

McHENRY MOSIER

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

BUREAU OF MINES EXPLORATION OF MERCURY DEPOSITS TO JUNE 30, 1944[1]

By McHenry Mosier[2]

SUMMARY

Mercury is one of the strategic metals the supply of which has been raised from critical uncertainty to more than enough for essential demands. Work by the Bureau of Mines has contributed substantially to increased production of mercury in the United States and to consequent accumulation of Government stocks. Other contributing factors were higher prices for mercury and Government loans to operators. The Bureau has undertaken 15 exploration projects, 13 of which have been completed. This work comprised 40,307 feet of drilling and 33,082 linear feet of surface trenching and has indicated commercial ore containing 37,400 flasks of mercury and marginal ore containing 29,200 flasks - a total of 66,600 flasks, equivalent, respectively, to domestic production at 50,000 flasks per year, for 9 months, 7 months, and 16 months.

Early in 1944, as Government stocks had become adequate, domestic production was gradually curtailed through cancellation of Government contracts for the purchase of mercury and Government control of labor and operating supplies.

INTRODUCTION

Mercury was one of the seven metals designated strategic by the Army and Navy Munitions Board in 1939, when Congress appropriated funds for the investigation of domestic sources of supply of war minerals. The Bureau of Mines immediately started a limited search for strategic minerals, but the first mercury project was not begun until December 1940.

The Federal Geological Survey assisted in the search for cinnabar by contributing information on domestic mercury deposits, preparing maps, and making geological studies of exploration projects. Details of geological studies of these and other mercury prospects may be found in reports by the Geological Survey. The high rate of production of mercury in the United States in 1943 was encouraged by the increase in price to $196 per flask at New York (see appendix A) and Government loans to operators for mine development and plant construction.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7299."

[2] Chief, Copper Division, Bureau of Mines.

The Bureau has tested mercury ores from six deposits in addition to ores from exploration projects to determine the most suitable method of treatment. Generally, either direct furnacing or pretreatment by flotation was applicable.

The standard metallurgical practice for ordinary ores of mercury is so simple that ore dressing (except crushing and screening) in advance of furnacing seldom proves profitable at modern plants. A concentrator is not required at any of the large mercury mines in the United States. Only for complex or refractory ores are such processes useful as flotation and hydraulic classification in connection with the discarding of finely divided particles of clay. Heretofore, hydrometallurgical treatment has not proved economic on crude ore.

Almost all samples taken at exploration projects are sent to the Bureau's laboratories for assay and chemical analyses.

The Bureau of Mines has issued, for restricted distribution subject to wartime controls, 19 War Minerals Reports on individual mercury deposits. In March 1942 it also published a Progress Report of the Metallurgical Division, Report of Investigations 3627, Cinnabar-Reduction Plants of the Southwestern Arkansas Quicksilver District.

OBJECTIVE OF EXPLORATION

The Bureau of Mines performs exploration principally (1) to increase ore reserves by delineating known mineral deposits, (2) to find additional ore bodies along mineralized zones that have proven productive, and (3) to determine the feasibility of exploitation of deposits. The Bureau is particularly interested in deposits that may contain large quantities of metals, including lean ores and those of marginal grade, but does not undertake primary prospecting or regional search for minerals. The ultimate purpose of the Bureau's exploration is to increase production of metals for war.

PROCEDURE IN EXPLORATION

The Bureau of Mines obtains preliminary information concerning mineral deposits in numerous ways. Many deposits are called to its attention by other Government agencies, some by property owners or mine operators, and some by its own staff. Those that appear to have merit in connection with the Bureau's war program are examined by one of its engineers. (See appendix B.)

Some mercury deposits are so erratic that it is virtually impossible to block out ore in advance of its actual extraction. Such deposits generally can be explored only as they are mined.

At deposits where exploration seems warranted, relative priorities are assigned and work is begun as soon as funds, manpower, and equipment are available.

Although it employs the common methods of exploration with some innovations, the Bureau has relied chiefly upon diamond drilling and surface trenching. Diamond drilling cannot be utilized fully at every mineral deposit, but it has proved satisfactory wherever it has been tried by the Bureau. The objective is to determine subsurface conditions and to indicate ore rather than to block out measurable reserves. This method is flexible, speedy, and economical. Early in the exploration program the smallest standard bit (EX, 7/8-inch core) generally was used, but later, the next size (AX, 1-1/8-inch core) also was employed to obtain better core recovery and larger samples.

The Bureau usually lets contracts to individuals and firms in private industry for diamond drilling, churn drilling, and bucket drilling, either through competitive bidding or by negotiation. Where bulldozers can be used for surface trenching, equipment and operator are contracted on an hourly basis. The Bureau also owns a few drills and bulldozers which it uses on exploration work. Bureau engineers supervise all the work at the projects, conduct the sampling, calculate the reserves, and interpret the results. Most of the assaying and all of the ore-dressing tests are performed in Bureau laboratories.

SUMMARY OF WORK PERFORMED AND ORE RESERVES INDICATED

Following is a summary of all exploration for mercury by the Bureau of Mines and the resulting ore reserves to June 30, 1944.

Summary of exploration for mercury by Bureau of Mines and resulting ore reserves to June 30, 1944

Project	Drilling, feet[1]	Underground development, feet	Surface trenches, linear feet	Indicated Ore Reserves			
				Commercial		Marginal	
				Tons	Hg/ton, lb.	Tons	Hg/ton, lb.
401	[2]3,784	-	-	-	-	113,000	2.0
402	-	28	8,193	2,200	10.5		-
403	3,539	-	5,309	-	-	-	-
405	9,118	-	-	181,000	7.5	560,000	2.5
406	2,580	-	-	-	-	-	-
407	-	58	240	-	-	171,000	2.0
408	2,496	-	-	76,000	3.0	-	-
410	5,700	-	-	-	-	-	-
412	[3]1,500	-	-	4,000	10.0	[4]164,000	1.5
414	-	229	10,056	28,400	28.0	-	-
416	-	-	-	[4]56,500	2.3	-	-
416	1,000	-	9,284	34,500	2.3	-	-
420	6,745	-	-	-	-	-	-

See footnotes on page 4.

Summary of exploration for mercury by Bureau of Mines and resulting ore reserves to June 30, 1944 (Cont'd.)

Project	Drilling, feet1/	Underground development, feet	Surface trenches, linear feet	Indicated Ore Reserves			
				Commercial		Marginal	
				Tons	Hg/ton, lb.	Tons	Hg/ton, lb.
421	-	-	-	5/7,000	32.2	-	-
422	2,845	-	-	-	-	X	2.0
423	1,000	-	-	-	-	-	-
Total	40,307	315	33,082	389,600	7.4	1,008,000	2.2
Flasks mercury (contained in ore)				37,400		29,200	
Total flasks mercury (contained in ore)				66,600			

1/ Diamond drilling, unless otherwise specified.
2/ Bucket drilling.
3/ Churn drilling.
4/ Mine dumps.
5/ In addition, 7,600 tons of inferred ore containing 31.4 percent mercury per ton.

RESULTS AT INDIVIDUAL PROJECTS

All Bureau of Mines exploration projects for mercury and the results obtained from them to June 30, 1944, are described below:

Project 401. Inyo County, Calif.

This deposit was bucket-drilled, trenched, and sampled early in 1941, and 113,000 tons of material was indicated to contain 2 pounds of mercury per ton.

The rocks consist of altered rhyolite, granite, and breccia. The ore minerals are cinnabar and metacinnabar, in a gangue of quartz, pyrite, hematite, limonite, alunite, sulfur, gypsum, a cadmium salt, mica, chalcanthite, and feldspar. The ore occurs in an area of active hot springs. It ranges from a soft, claylike substance to hard, compact opal. Diamond drilling did not appear advisable as a method of prospecting because of the probable inability to obtain a satisfactory core recovery. Test pits to the required depth were impracticable owing to solfataric action and to the rock temperature, which attained a maximum of 235° F. At this project, 3,784 feet of hole 16 inches in diameter3/ was drilled with a rotary bucket.4/ This is believed to be the first application of a "cesspool digger" to prospecting for mercury. In addition, 9,665 feet of new roads were constructed to drill sites and 11,552 feet of old roads were reconditioned.

This submarginal deposit is a potential reserve for future exploitation should a national emergency require it.

3/ Includes 184 feet of hole 26 inches in diameter.
4/ Mosier, McHenry, and Johnson, A. C., Exploration For War Minerals (Through fiscal year 1942): Rept. of Investigations 3676, 1943, 44 pp.

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Project 402. Bottle Creek District, Humboldt County, Nev.

During the past 4 years, 5,000 flasks of mercury was produced in this district. Three types of ore bodies were noted in the district: Cinnabar-bearing fault zones; mineralized diabase dikes characterized by small, rich ore shoots in the hanging wall of the dike; and cinnabar-bearing rhyolite dikes. Fault zones in proximity to diabase dikes are the most important and account for 80 percent of the total production. They constitute the most important inferred-ore reserve. In 1940 and 1941, 6,210 linear feet of trenching with bulldozers, 1,983 linear feet of hand trenching, and 28 feet of shaft sinking indicated 2,200 tons of commercial ore containing 10.5 pounds of mercury per ton, in addition to considerable submarginal ore. Most of the work was in the central part of the district, although the northwestern and eastern-central parts were also examined. Showings of cinnabar in sufficient quantity to merit detailed sampling were found in only two of the areas prospected, these being the McAdoo north fault zone, where surface trenching and sampling indicated an area of 630 square feet with a unit content of 10.86 pounds mercury per ton, and the Baldwin south rhyolite, where sampling of open-cuts and a 30-foot shaft on the contact of a rhyolite dike gave an estimated weighted average of 3.4 pounds mercury over a width of 3.9 feet. As all the commercial ore has now been mined, the district has virtually no measurable commercial reserves, although further prospecting may develop additional ore.

A magnetometer survey of only 10 acres by the Geophysical Section of the Bureau of Mines in Fedruary 1943 indicated three diabase dikes in addition to the 14 previously known in the district.

Project 403. Pike County, Ark.

The Bureau explored five properties in 1941 in the western part of this quicksilver-producing district, which is about 26 miles long by 6 miles wide. Work was done in six 40-acre tracts in the Hale & Hintze, Gap Ridge, Hopkins Hill, and Parnell Hill ares.

Trenches aggregating 5,309 linear feet were excavated by bulldozers, 12 holes aggregating 3,539 feet were diamond-drilled, and 267 100-pound samples were taken and assayed. The trenches ranged in width from 10 to 40 feet, and in depth from 0.5 to 6 feet. A small amount of submarginal material was discovered, but no significant quantity of commercial ore was indicated by the Bureau's work.

Ore bodies of commercial grade are usually small in size, ranging from 6 square feet to 300 square feet in horizontal area. Ordinarily, the operating companies are working bodies of ore ranging in size from 25 to 100 square feet in horizontal area. In general, favorable locations of mercury deposits are near the thrust faults, and the tear faults, or in a fractured sandstone of the cross folds.

Favorable areas for further exploration as determined by the project are: (1) Parnell Hill, along the sandstone beds north of the shale-sandstone contact; (2) Hopkins Hill, west along the sandstone beds, in which the pit over hole 12 is located; (3) Gap Ridge along the sandstone beds in which the Gap Ridge stope is mined; (4) east of hole 3, an area crossed by a tear fault; (5) East Gap Ridge, along the sandstone bed in the upper part of the Gap Ridge sandstone. These areas might include some low-grade deposits.

Project 405. Valley County, Idaho

This project was on Cinnabar Creek, about 12 miles by road from Stibnite. The deposit was first worked about 1917, but considerable development work was done in 1926.

The ore occurs as fracture filling and dissemination in metamorphosed limestones near a limestone-quartzite contact. The limestone has been brecciated, crushed, and silicified in varying degrees by shear zones and faulting. The cinnabar is accompanied with sparsely disseminated pyrite.

During 1941 and 1942 the Bureau drilled 9,118 feet, which increased the indicated ore reserves to the following:

Class of ore	Tons	Hg/ton, lb.	Total flasks Hg	Cut-off Hg/ton, lb.
Commercial	181,000	7.5	17,800	4
Marginal	560,000	2.5	18,500	2
Submarginal	231,000	1.1	3,400	1

This was one of the outstanding projects of the Bureau's exploration program for mercury. Such substantial reserves justified installation of a second rotary furnace, which was undertaken by the operators in October 1942. About 140 tons of ore per day was being produced by the square-set method of stoping in the fall of 1943, when the output of mercury was 400 flasks per month. Production stopped in June 1944, on account of market conditions.

The Bureau of Mines made ore-dressing tests to determine methods of handling the clayey ore found in some parts of the deposit. These indicated that 35 to 40 percent of the clayey material could be discarded by disintegration and hydraulic classification with a loss of only 3 to 7 percent of the mercury. The remaining product then is suitable for dewatering and direct furnacing.

Project 406. San Benito County, Calif.

Sixteen diamond-drill holes from both surface and underground, totaling 2,580 feet, comprised exploration by the Bureau at this project from November 1941 to June 1942. More than 50 percent of the drilling was done with AX bits, about 20 percent with EX, 20 percent with BX, and 10 percent with NX. The maximum depth of hole drilled was 412 feet. Although the narrow, lenticular bodies of ore offer a small-size objective for discovery by diamond drilling from the surface, yet this drilling developed information regarding ore structures that proved valuable to the operators in planning the underground prospecting that led directly to the discovery of high-grade cinnabar.

This ground was more difficult to drill than that at any other Bureau project. Much of the drilling was in broken, hard, silicified sandstones and shales that yielded poor core recovery. Penetration was slow, in a few instances only 1 to 3 feet per shift. Several holes from the surface had to be abandoned before their objectives could be reached. The acidity of the underground water, the presence of methane, and the tendency of the ground to cave easily made cementing impracticable in many holes.

This deposit was one of the largest producers of mercury in the United States in 1943, the output being about 1,500 flasks per month. Quicksilver was discovered here in 1850, but production did not begin in any appreciable quantity until about 1861. The total production from the deposit is said to be about 400,000 flasks. The ore mineral is cinnabar associated with various amounts of pyrite. Other gangue minerals are quartz, calcite, dolomite, gypsum, and in places masses of a bituminous mineral. Cinnabar occurs principally as small veinlets along fractures or bedding planes of the silicified sandstone and shale. The thickness of the veinlets varies from the thickness of a sheet of paper to as much as one-half inch. In a few instances the ore is crystallized in little rosettes, locally known as "strawberries," and are found as large as 1 inch in diameter. The fracturing of the rock releases the cinnabar to a large extent as fines, and therefore these fines run higher in mercury than the coarser material.

The principal ore bodies have been found in the silicified and fractured Panoche sandstone and shale. The flattening of the dip of a fault and cross faults forming an inverted trough with the hanging wall of silicification are the most favorable locations for ore deposits. These inverted troughs are at all the larger bodies that have been mined. Square-set stoping is the standard system of mining.

Project 407. Silver Spots. Humboldt, Washoe, Esmeralda, Pershing, Nye, Elko, Mineral, and Storey Counties, Nev., and Malheur County, Oreg.

The object of this project was to develop sampling data at known deposits, to designate areas for exploration by the Bureau, and to aid operators in maintaining current production. Twenty-five properties were sampled and their ore reserves calculated. Exploration in connection with this work included 240 feet of trenching, 28 feet of test pitting, and 30 feet of underground development. 4,271 samples were taken from November 1941 to August 1942. The principal properties sampled were:

Property	County	State
The Rand mine	Elko	Nevada
B & B mine	Esmeralda	Do.
Pershing mine	Pershing	Do.
Washington Hill	Storey	Do.
Mercury Mining Co.	Nye	Do.
Last Chance	Humboldt	Do.
Buckskin Peak	do.	Do.
Cordero mine	do.	Do.
Bretz mine	Malheur	Oregon

171,000 tons of marginal ore containing 2 pounds of mercury per ton was indicated by this work. The Bureau's exploration project 412 resulted directly from the "silver spots" sampling.

Rand Mine

The Rand mine, Elko County, also known as the Bower estate, is in the Ivanhoe district 50 miles from Battle Mountain, Nev.

Mercury was discovered in this district about 1910. Considerable activit was maintained from 1916 to 1918 and again during the present high price of mercury caused by war demands. From 1927 to 1940, 400 flasks of the metal were obtained from the Rand and Governor mines.

The principal economic rocks of the district are volcanic flows and sedimentaries, underlain by quartzites and cherts. Cinnabar occurs in fault or fissure zones and in blanket, opalite deposits, the latter being the principal source of mercury. The ore consists of cinnabar, mercury chloride, and native mercury.

The Velvet workings of the Rand mine are the principal source of ore. The property is equipped with a 25-ton furnace and condensing system and camp accomodations for 12 men.

B & B Mine

Production from the B & B mine, Esmeralda County, Nev., was estimated at 62,000 tons of ore, from measurements of the open-cuts.

Certain beds of opalized breccia are favorable host rocks. The ore follows the bedding as well as fractures across the bedding and forms a gently dipping deposit the mercury content of which in many places decreases at shallow depths. Ore also occurs in and near a prominent fault.

The mine workings consist of a main adit about 800 feet long, a lower adit 364 feet, and other adits totaling 138 feet. The main ore zone has been mined from two glory holes and a number of smaller pits.

632 samples were taken by the Bureau of Mines (December 1941). The shallow ore makes open-cut mining the best method.

Pershing Mine

The Pershing mine, Pershing County, Nev., northeast of Lovelock, was sampled in March and April 1942 by the Bureau of Mines.

The formations are shale, limestone conglomerate, sandstone, and dike material. The most favorable locus of mineralization is the limestone conglomerate, which ranges in thickness from 8 to 100 feet and outcrops more than a mile. The highest-grade ore is close to the shale on the hanging-wall side and next to the sandstone on the foot wall. 418 samples were taken.

Washington Hill Mine

The Washington Hill mine is at 6,000 feet elevation, in Storey County, Nev., 12 miles from Sparks.

Mercury was produced from a small open pit before 1942. Ore is exposed on one side and the bottom of the pit and in two outcrops south of this opening. 229 samples were taken by the Bureau of Mines (February 1942).

There are no buildings or plant equipment on the property.

Mercury Mining Co.

The property of the Mercury Mining Co. is in the Union mining district, at 8,000 feet elevation, 2-1/2 miles from Ione, Nye County, Nev.

The mine plant was dismantled about 1922. The exact production record is not available, but at least 1,400 flasks of mercury was produced.

The production was obtained from glory holes and small stopes near the surface, which were developed by adits. These workings indicate two parallel mineralized zones. The ore remnants around the old stopes are being mined and treated in a four-pipe retort (May 1942).

The property was sampled by the Bureau of Mines.

Last Chance

The Last Chance mine, formerly known as the White Peaks, is about 60 miles northwest of Winnemucca, Humboldt County, Nev., in the Bottle Creek mining district at an altitude of 5,500 feet.

From 1939 to September 1, 1942, 877 flasks of mercury was produced.

The ore has been mined from a diabase dike averaging 14 feet wide. It has been developed to a depth of 162 feet and for a length of 320 feet along the strike. Rhyolite overlies the dike on the north.

The mine workings consist of the Scossa shaft 162 feet in depth and 579 feet of drifts and crosscuts on three levels.

A 22-inch, oil-fired, rotary furnace, with a capacity of 20 tons per 24 hours, is on the property, together with a 40-hp. Diesel plant, air compressor, gasoline-power hoist, and miscellaneous mine machinery.

The Bureau of Mines took 63 samples in the workings.

Buckskin Peak

The Buckskin Peak mine is in Humboldt County, Nev., about 76 miles north of Winnemucca at an altitude of 8,700 feet. The property was discovered in 1928. Production in 1938 was 58 flasks of mercury, and in 1941 about 3,000 tons of ore was treated, from which 50 flasks of mercury was produced.

The rocks at the property and vicinity consist of a basal formation intruded by granitic dikes. These rocks are overlain by lavas with intercalated sediments. Mercury ore occurs in siliceous sinter overlying these rocks.

In some places massive cinnabar forms layers and small masses, but it is mostly finely disseminated through a chalcedonic and opaline gangue.

A 560-foot tunnel was driven through the hill, connected by raises to three short tunnels. The ore body is not delimited by these workings.

In June and July 1942 the Bureau of Mines took 305 samples from underground workings and surface exposures.

Project 408. Lane County, Oreg.

This project was 17 miles from Cottage Grove, the nearest railroad station, at about 1,200 feet altitude. The deposit was discovered in the early eighteen nineties.

The rocks are andesite flows and intrusives, volcanic tuffs and breccia, and a dense, hard rock locally called basalt, although an exact determination has not been made.

Mercury occurs near several fault zones and at bedded-tuff contacts as cinnabar with subordinate amounts of metacinnabar and native quicksilver. The walls of the ore shoots are not definite and are determined by assays.

The deposit has been extensively developed through adit tunnels. 300,000 to 400,000 tons of ore has been mined, and about 14,000 flasks of mercury has been produced.

The Bureau of Mines completed an exploration program in August 1942. It consisted of diamond-drilling seven holes totaling 2,496 feet and cutting 900 samples on the 400-, 900-, and 1,100-foot levels. 76,000 tons of ore containing 3.0 pounds of mercury per ton was developed by this program. As the ore bodies were not completely delineated, additional ore may be found.

The buildings consist of furnace house, office, boarding house, and six dwellings, all of which need repairing. The equipment consists of a 200-ton crushing unit, a 100-ton crushing unit, a 4-foot by 60-foot Gould furnace with motors, feeders, blowers, bins, condensing system, and also a blacksmith shop.

Project 410. Terlingua District, Brewster County, Tex.

This project was begun in June 1943, and 5,700 feet were drilled to December 1943, when the project was completed. The work has been done at two areas, from surface set-up and underground stations. From the surface at one, 11 holes ranged in depth from 160 to 1,178 feet; from underground, at the other, 4 holes from 47 to 287 feet and from the surface, 5 holes from 232 to 362 feet. Structures favorable for ore deposition include (1) the contact between Devils River limestone and Del Rio clay, (2) cinnabar-bearing calcite veins, and (3) breccia pipes. Although no commercial ore reserves have been indicated by this exploration, two veins containing cinnabar were found on which underground development might be justified.

Project 412. Humboldt County, Nev., and Malheur County, Oreg.

This deposit is near the Oregon-Nevada line and McDermitt, Nev. It has produced about 11,500 flasks of mercury since its discovery in 1931.

The rocks consist of volcanic tuff, breccia, and agglomerate, with a few flows and lake sediments. The last are largely shales associated with sandstone and conglomerate. The tuffs have been silicified in places to form chalcedony, locally known as "opalite." Cinnabar occurs in the silicified volcanic rocks, but most of the ore mined came from the soft lake beds. The ore bodies range in width from 20 to 50 feet and in length from 100 to 300 feet. Ore containing 4 pounds of mercury per ton was mined to depths of 100 feet.

The known high-grade ore bodies had become depleted, and in the spring of 1942 the Bureau of Mines sampled the dumps and sides of the pits. This work disclosed 164,000 tons of 1.5 pound marginal ore - 72,500 tons in the dumps and 91,500 tons in the margins of the pits.

Efforts were made by the Bureau to excavate trenches with a bulldozer in the fall of 1943; but the overburden, containing many large opalite boulders, was difficult to move, and that work was abandoned.

Between October 1942 and March 1943 the Bureau churn-drilled 25 holes aggregating 1,500 feet and excavated three trenches with a bulldozer. Trenching was found to be impracticable and was abandoned. 290 samples were taken.

Erratic mineralization makes it difficult to estimate tonnage or grade of the ore reserves. However, underground development and churn-drill holes indicated 8,200 tons of ore containing 10.3 pounds of mercury per ton, as of March 1943. Of this, 4,000 tons containing 10 pounds of mercury per ton was indicated by a joint drilling program by the Mining Company and the Bureau of Mines. The company continued churn drilling in areas outlined by the Bureau and has developed considerable additional ore.

Project 414. Sleitmut Area, Alaska

The Sleitmut area is in southwest Alaska on the Kuskokwim River about 8 miles from the village of Sleitmut. The Bureau has investigated five properties in this area on which are three mercury deposits - two commercial and one marginal. These properties are the Red Devil, Alice and Bessie, Barometer, Willis, and Fairview. 10,056 linear feet of surface trenching and 229 feet of underground development was done by the Bureau.

The ore deposits are found in an area of about 10 square miles paralleling the Kuskokwim River and are closely associated with altered andesite porphyry dikes and sills that intrude graywackes, shales, and sandstones. Cinnabar and stibnite occur along the hanging wall of the andesite in both the porphyry and the sediments. 10,056 linear feet of trenching was done by the Bureau during the summer of 1942 and 229 feet of underground work from December 1942 to March 1943.

This exploration indicated 28,400 tons of ore containing 28.0 pounds of mercury per ton, using a 6-pound cut-off. The inferred ore is several times that amount.

The indications are that further exploration will materially increase the ore reserves of the district.

One deposit is being exploited; a 40-ton rotary furnace was installed in September 1943.

In the laboratory, good recoveries of antimony and mercury were obtained from the Sleitmut ore by gravity, flotation and retorting tests.

Project 416. Santa Clara County, Calif.

This deposit is 10 miles south of San Jose. Approximately 111,000 flasks of mercury has been produced since it was first worked in 1856. It has been idle since 1920 but in 1943, owing to the high price of mercury, operations were resumed.

The Bureau of Mines sampled mine dumps, trenched, and diamond-drilled promising areas. The larger dumps were trenched to bedrock by drag lines. Several bulldozer cuts were excavated in surface material. From these exposures, 419 samples were taken. Favorable silica carbonate rock was diamond-drilled, seven holes totaling 1,000 feet. The project was completed in March. 1943.

The mine dumps contain 56,500 tons averaging 2.26 pounds of mercury per ton. Surface material contains an indicated 34,500 tons containing 2.3 pounds per ton, which can be mined by open-cut methods. The operators have

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sunk a shallow shaft near one of the Bureau's drill holes and have found an undetermined quantity of high-grade ore. A rotary furnace has replaced an antiquated reduction plant.

Project 420. Santa Clara County, Calif.

This deposit is in Santa Clara County, Calif., about 12 miles from San Jose. The deposit was discovered in 1824, but production did not begin until 1845.

The ore bodies occur in a silica carbonate rock on the contact between serpentine and sandstones and other sedimentary rocks. A clay gouge, locally known as "alta," generally is found on the hanging wall. The principal mineral is cinnabar, usually associated with metacinnabar and free mercury. Pyrite, quartz, calcite, chalcedony, and bituminous material also occur. Ore bodies have been followed to a depth of 2,450 feet from surface.

The Bureau of Mines started diamond drilling in August 1943 and by June 30, 1944, had drilled 6,745 feet. Some ore was found in two holes, structure and contacts have been determined, and a promising thickness of silica-carbonate rock, a favorable host for ore, has been penetrated at several points.

Project 421. Alaska

This project was near the Kuskokwim River 23 miles north of the village of Crooked Creek and 44 miles south of the town of Flat.

The rocks are mostly sandstone and carbonaceous shale intruded by andesite porphyry. The higher-grade ore bodies occur along an igneous contact or in the sediments near the contact. Shaly sandstone or alternating beds of shale and sandstone are favorable zones for mineralization. The principal minerals are cinnabar, stibnite, cervantite, and arsenopyrite associated with siliceous material and a small amount of carbonate and kaolin. Nine veins have been exposed by prospecting since 1927. Beginning in June 1943, the Bureau of Mines sampled the workings and trenched and stripped with a bulldozer a portion of No. 1 ore body. Work by the Bureau disclosed five zones of cinnabar ore in an area 1,800 feet long and 385 feet wide, which contained 7,000 tons of indicated ore averaging 32.2 pounds of mercury per ton and 7,600 tons of inferred ore carrying 31.4 pounds per ton.

In October 1943 the Bureau completed its exploration.

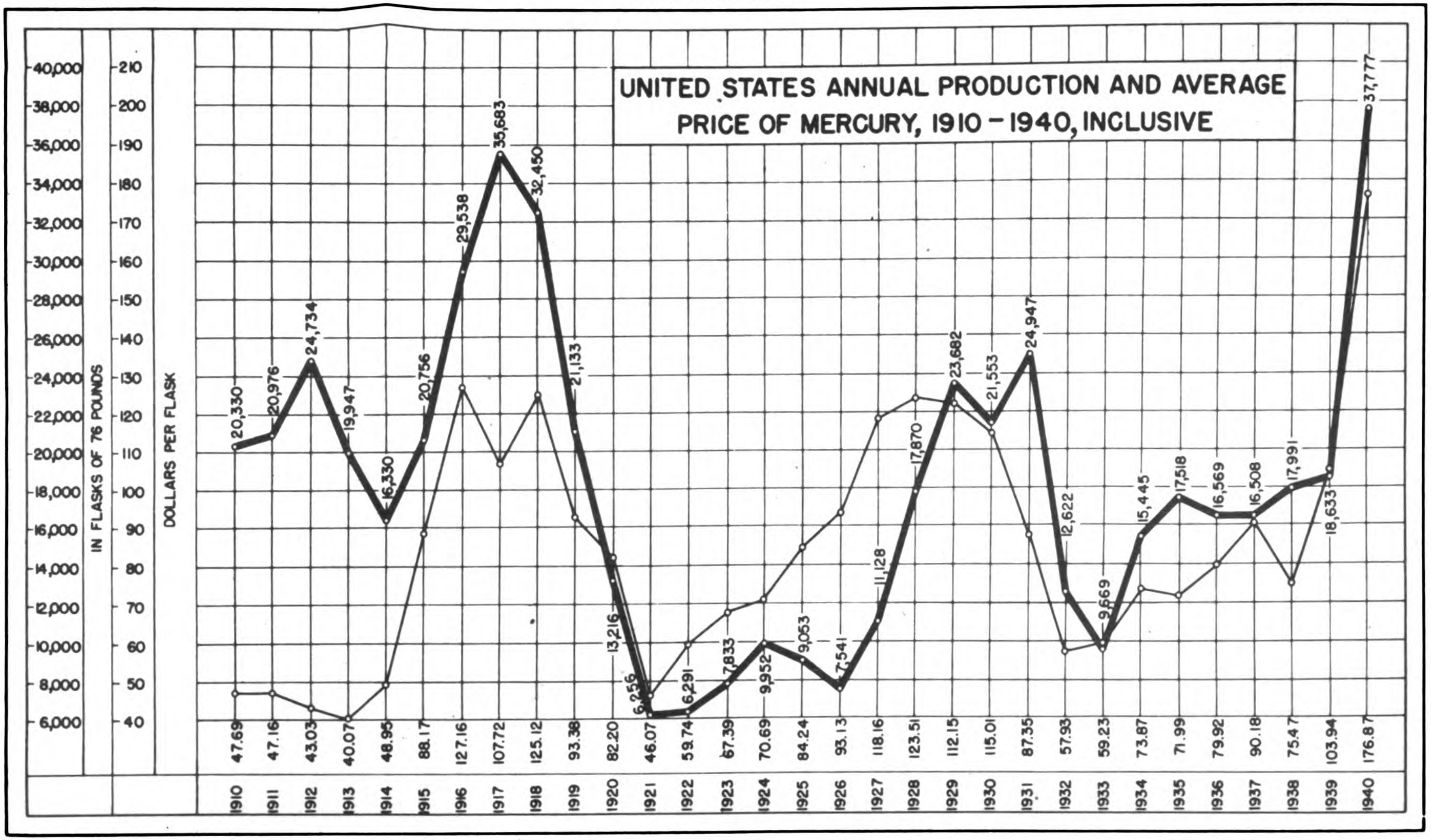
As this was the least accessible of the Alaska projects, the Bureau assisted the mine operators to complete an airfield with 1,000-foot landing strip.

The mining company installed two D-type retorts in September 1943. During 1943, 109 tons of hand-sorted ore containing 600 pounds of mercury per ton was mined.

CONCLUSIONS

The program of the Bureau of Mines for investigations of mercury contributed greatly to increased production of mercury and to consequent accumulation of Government stocks. The Bureau is continuing a small amount of exploration for mercury as a safeguard against any unforeseen contingencies in the present national emergency.

APPENDIX A


UNITED STATES ANNUAL PRODUCTION AND AVERAGE PRICE OF MERCURY, 1910 – 1940, INCLUSIVE
IN FLASKS OF 76 POUNDS
DOLLARS PER FLASK
40,000
38,000
36,000
34,000
32,000
30,000
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
20,330
20,976
24,734
19,947
16,330
20,756
29,538
35,683
32,450
21,133
13,216
6,256
6,291
7,833
9,952
9,053
7,541
11,128
17,870
23,682
21,553
24,947
12,622
9,669
15,445
17,518
16,569
16,508
17,991
18,633
37,777
47.69
47.16
43.03
40.07
48.95
88.17
127.16
107.72
125.12
93.38
82.20
46.07
59.74
67.39
70.69
84.24
93.13
118.16
123.51
112.15
115.01
87.35
57.93
59.23
73.87
71.99
79.92
90.18
75.47
103.94
176.87
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940

APPENDIX B

Mercury examinations by Bureau of Mines to June 30, 1944

Location	No. of deposits examined
Alaska	3
Arizona	9
Arkansas	31
California	38
Colorado	2
Idaho	16
Michigan	1
Nevada	43
New Mexico	1
Oregon	27
South Dakota	1
Texas	11
Utah	2
Washington	3
West Virginia	1
Wyoming	1
	190